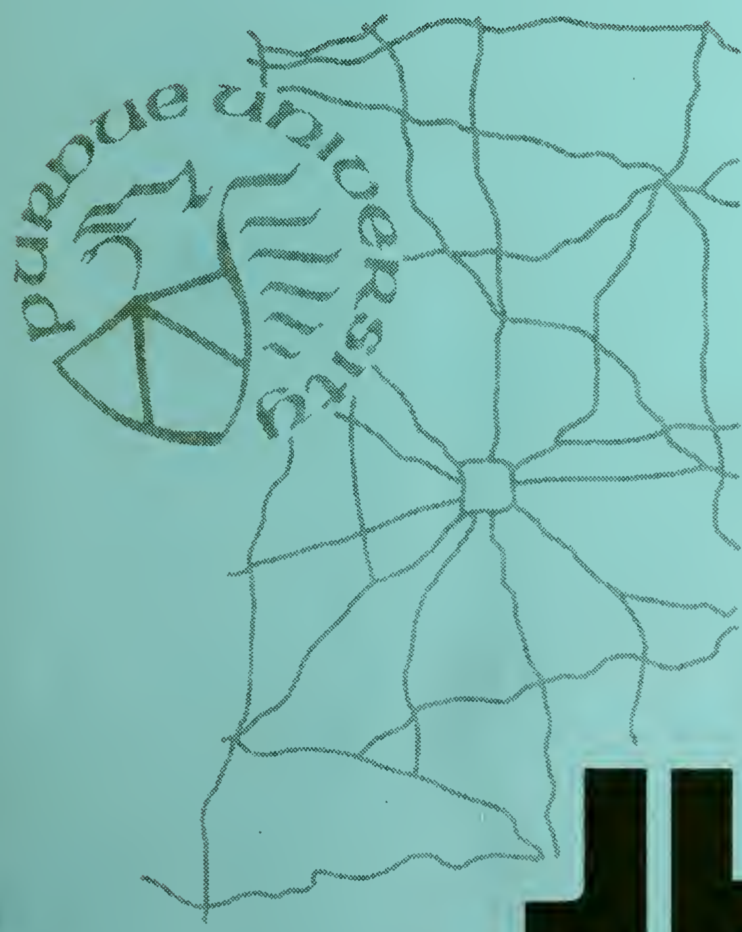
ENGINEERING SOILS MAP OF BENTON COUNTY, INDIANA

FEBRUARY 1969 — NUMBER 4



BY

P. T. YEH

JHRP

JOINT HIGHWAY RESEARCH PROJECT

PURDUE UNIVERSITY AND

INDIANA STATE HIGHWAY COMMISSION

Final Report

ENGINEERING SOILS MAP OF BENTON COUNTY, INDIANA

To: Dr. J. F. McLaughlin, Director
Joint Highway Research Project

February 14, 1969

File: 1-5-28-47

From: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-51 B

The attached report, entitled "Engineering Soils Map Of Benton County, Indiana", completes a portion of the project concerned with development of county engineering soils maps of the State of Indiana. This is the 47th report in the series. The report was prepared by P. T. Yeh, Research Engineer, Joint Highway Research Project.

The soils mapping of Benton County was done primarily by airphoto interpretation. Some soil test data along US 52 and US 41 provided by Indiana State Highway Commission are included in the report and generalized soil profiles of the major soil group are presented on the engineering soils map. An ozalid print of the Engineering Soils Map is included in the report.

Respectfully submitted,

Harold L. Michael

Harold L. Michael
Associate Director

HLM:rg
Attachment

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All airphotos used in connection with the preparation of this report automatically carried the following credit lines: "Photographed for Commodity Stabilization Service, Performance and Aerial Photography Division, United States Department of Agriculture."

Final Report

ENGINEERING SOILS MAP OF BENTON COUNTY, INDIANA

by

P. T. Yeh
Research Engineer

Joint Highway Research Project
Project No: C-36-51 B
File No: 1-5-26-47

Prepared as Part of an Investigation
Conducted by
Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with the
Indiana State Highway Commission

Purdue University
Lafayette, Indiana
February 14, 1969

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF BENTON COUNTY, INDIANA

by

P. T. Yeh

INTRODUCTION

The Engineering Soils Map of Benton County, Indiana which accompanies this report, was compiled from 7-inch x 9-inch aerial photographs having an approximate scale of 1:20,000. The aerial photographs were taken in September, October and December of 1938 in connection with the United States Department of Agriculture program and were purchased from that agency.

Aerial photographic interpretation of the landforms and engineering soils of this county was accomplished in accordance with accepted principles of observation and inference (1)*. Field trips were made to the area for the purposes of resolving ambiguous details and correlating aerial photographic patterns with soil textures. Standard mapping symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate landforms and soil textures. The text of this report largely represents an effort to overcome the limitations imposed by adherence to a standard symbolism.

Although no soil samples were collected and tested by the Joint Highway Research Project, general soil profiles were developed and are shown on the soils map. The soil profiles were compiled from the agriculture literature, information from the adjacent counties and from the boring data of the roadway soil survey along US 41 and US 52 supplied by the State

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* Figures in parentheses refer to references appearing in the bibliography.

Highway Commission.

Liberal reference was made to "The Formation, Distribution and Engineering Characteristics of Soils" (2). and to the "Soil Survey of Benton County, Indiana (3).

DESCRIPTION OF AREA

General

Benton County is located in the west central part of Indiana (Fig.1). The western boundary of the county is the Illinois-Indiana state line. Benton County is rectangular in shape, with a length of 23 miles (east-west) and a width of 18 miles (north-south). The total area of the county is about 409 square miles (4).

Fowler is the county seat and is located near the center of the county. A population of 11,912 inhabitants resided within the county, with 2491 reported for Fowler in the 1960 census (5).

According to the 1964 census of Agriculture, there were 253, 680 acres of farm land (about 96.9% of the county area in Benton County (6). Wooded areas are generally confined along streams on the eastern portion of the county as shown in the airphoto mosaic in Fig.2.

Drainage Features

The northwestern half of Benton County lies within the Kankakee drainage basin (Fig.3). A small area in the northeastern corner is in the Tippecanoe River subdivision of the Wabash drainage basin and the remainder of the county is in the Wabash drainage basin proper.

With the exception of Big Pine Creek all creeks and streams have their sources within the county. Most stream valleys are shallow. Surface drainage is best developed along the major streams. The density of the drainage patterns

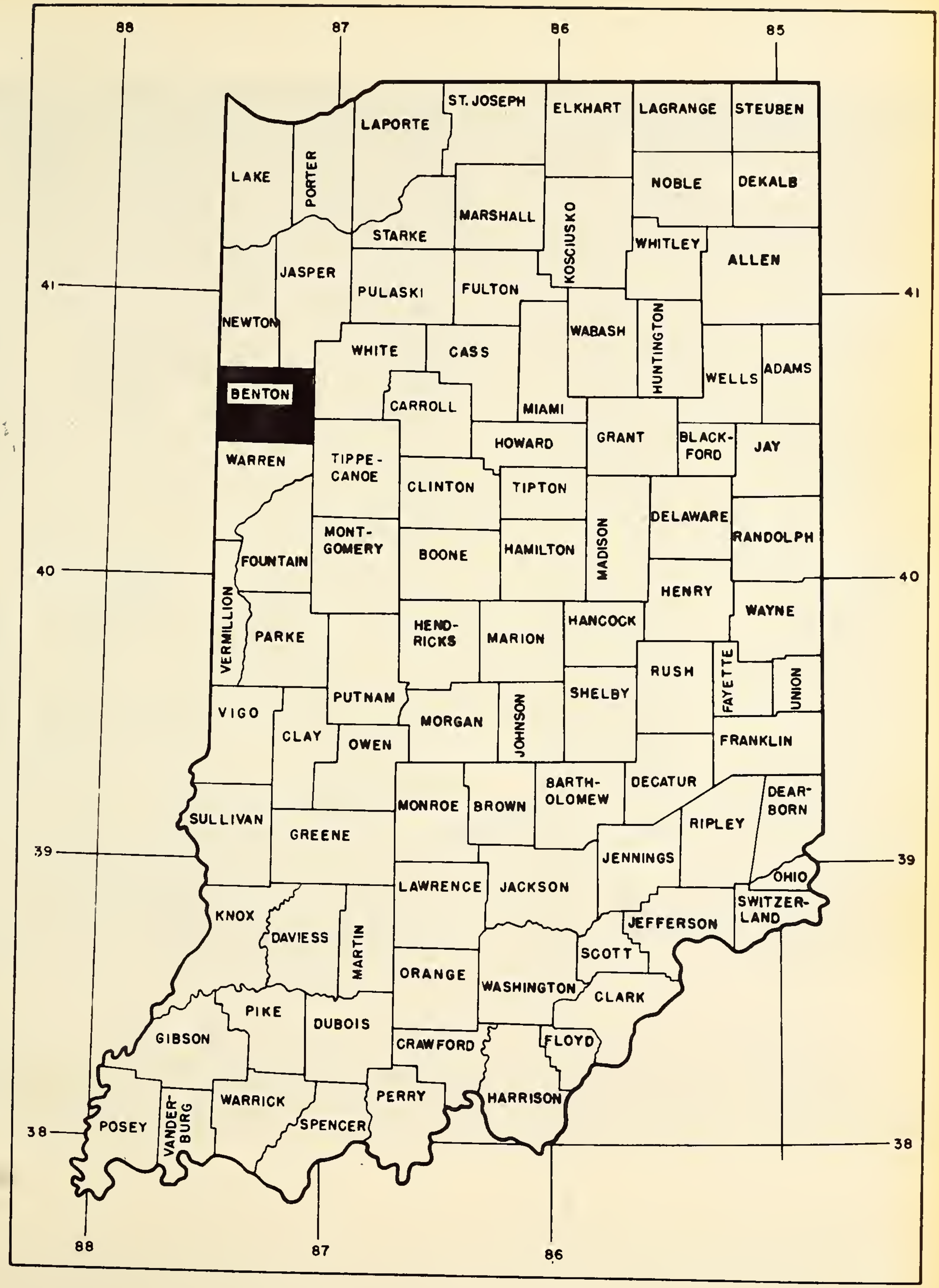


FIG. I LOCATION MAP OF BENTON COUNTY

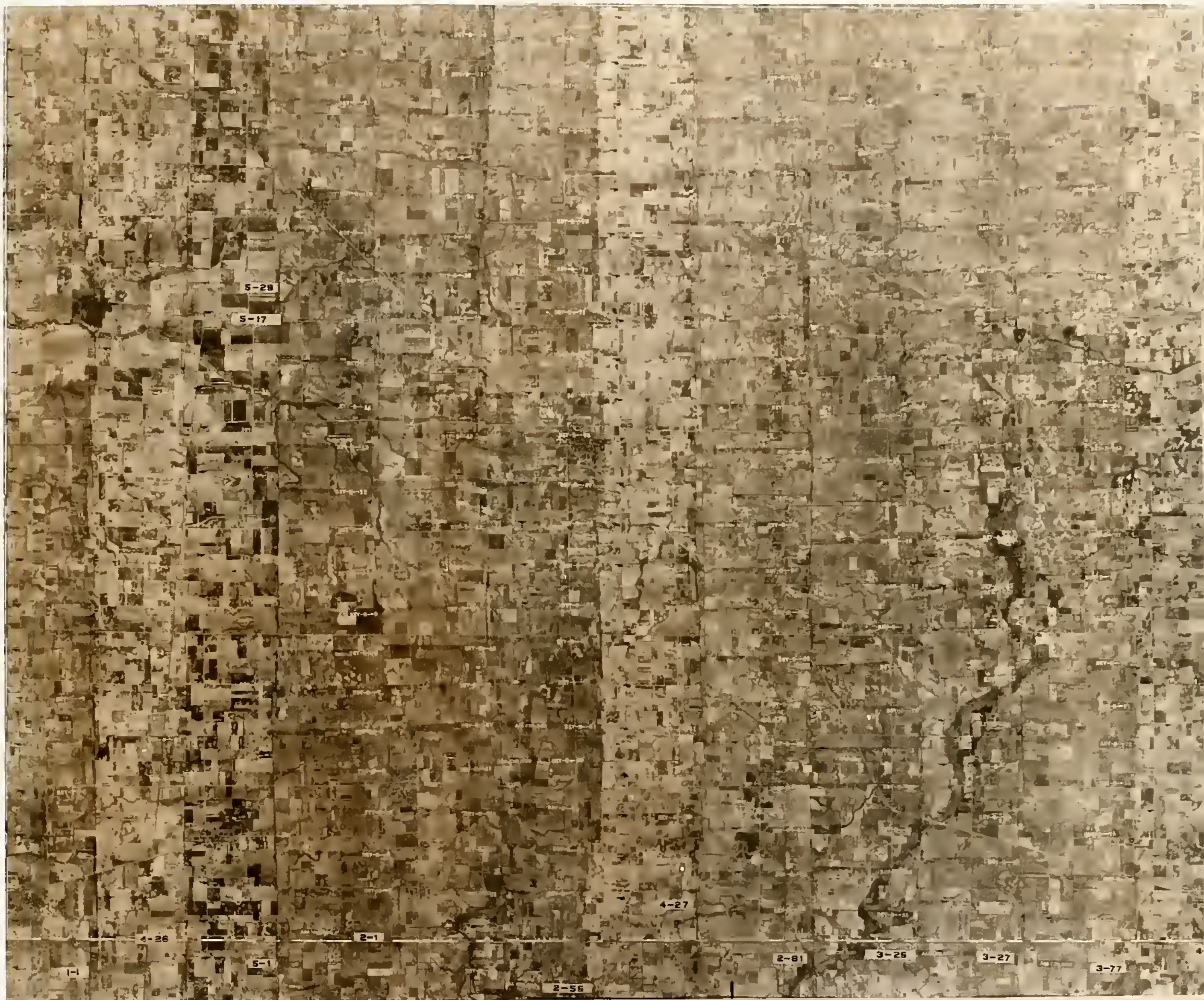


FIG. 2 AIRPHOTO MOSAIC OF BENTON COUNTY

FROM 1938 INDEX MAP

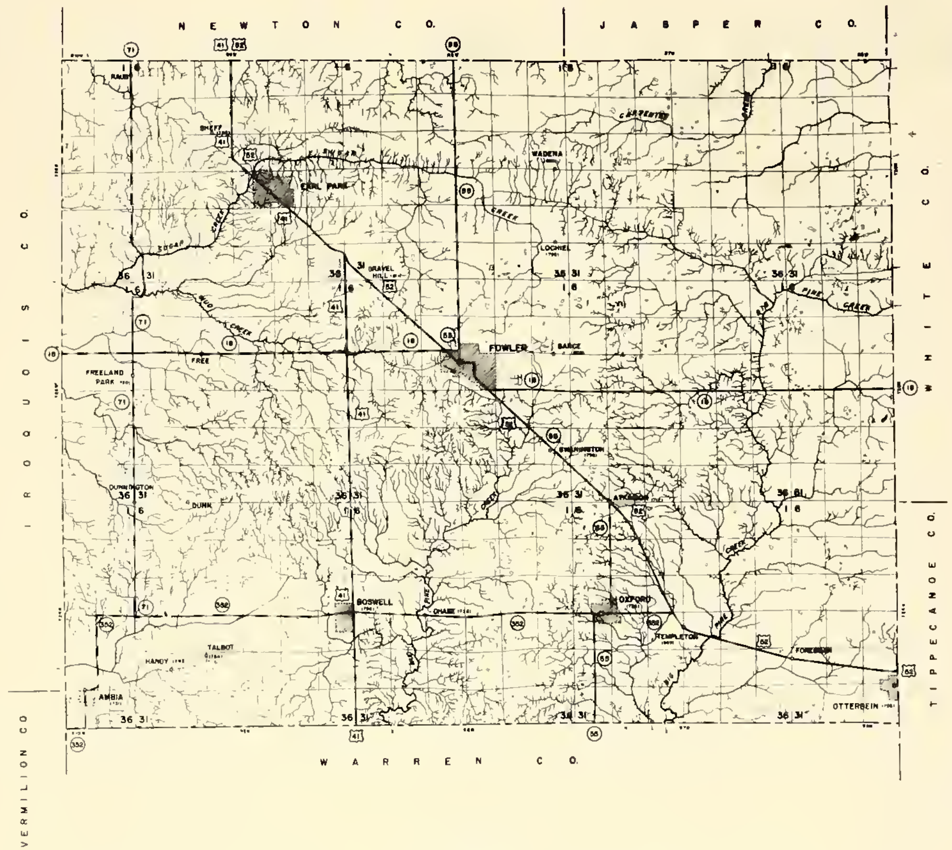


FIG. 3

DRAINAGE MAP

BENTON COUNTY

INDIANA

PREPARED FROM

1938 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1954

SCALE OF MILES

PREPARED UNDER THE SUPERVISION OF R. T. YEH

POLYCONIC PROJECTION

DRAWN BY W. E. HOOVER

in the central part is intensified by the presence of moraines. The construction of surface ditches throughout many sections of the county has improved sluggish drainage conditions. Even streams have been extensively dredged especially along Big Pine Creek and Sugar Creek.

There are no natural lakes in Benton County. However, a few ponds have been mapped. Some of the ponds are man-made. Others appear to be depressions formed by glaciation.

Climate

The climate of Benton County is continental, humid, and temperate. The warm humid and moderately cold winter are characterized by frequent sudden changes of temperature. The wide variations occuring within a season can be seen from the minimum and maximum temperature listed on Table I. The mean precipitation at Fowler (40 years record) is 36.05 inches. The driest and wettest year records are listed in Table I also.

Physiography

Benton County lies wholly within the Tipton Till Plains physiographic region of the State (Fig. 4). With respect to its physiographic situation in the United States, the county is a part of the Till Plain Section of the Central Lowland Province (7).

Topography

The monotonously flat topography in Benton County is broken by three rolling undulating morainic ridges. The northern one which runs in a east and west direction is known as Nebo-Gilboa ridge. It has two prominent knolls, Mount Nebo (about 2 miles east of Wedena) and Mount Gilboa (about 7 miles east of Lochiel), and has a rather prominent crest along the entire length. The two

Table I

NORMAL MONTHLY TEMPERATURE AND PRECIPITATION AT FOWLER, BENTON COUNTY, INDIANA
(Elevation 824 feet)

Month	Temperature			Precipitation		
	Mean[1] of	Absolute Maximum of	Absolute Minimum of	Average[2] Inches	Driest Year (1963) Inches	Wettest Year (1957) Inches
January	27.6	69	-21	2.04	0.44	1.63
February	29.9	68	-18	1.99	0.76	1.06
March	38.3	82	-9	2.73	4.64	0.82
April	50.8	90	18	3.68	4.70	7.00
May	61.5	97	26	3.94	0.83	4.98
June	71.7	105	33	4.36	1.52	6.86
July	75.8	111	40	3.90	5.40	9.25
August	73.9	104	40	2.72	1.90	2.89
September	66.9	102	27	3.15	0.50	2.45
October	55.8	92	19	2.95	0.77	3.94
November	40.6	80	-8	2.67	2.13	2.43
December	29.7	66	-15	1.92	0.57	4.77
Year	51.9	111	-21	36.05	24.16	48.08

1. The mean temperature is based on 37-year records.
2. The average precipitation is derived from the data collected in 40 years.

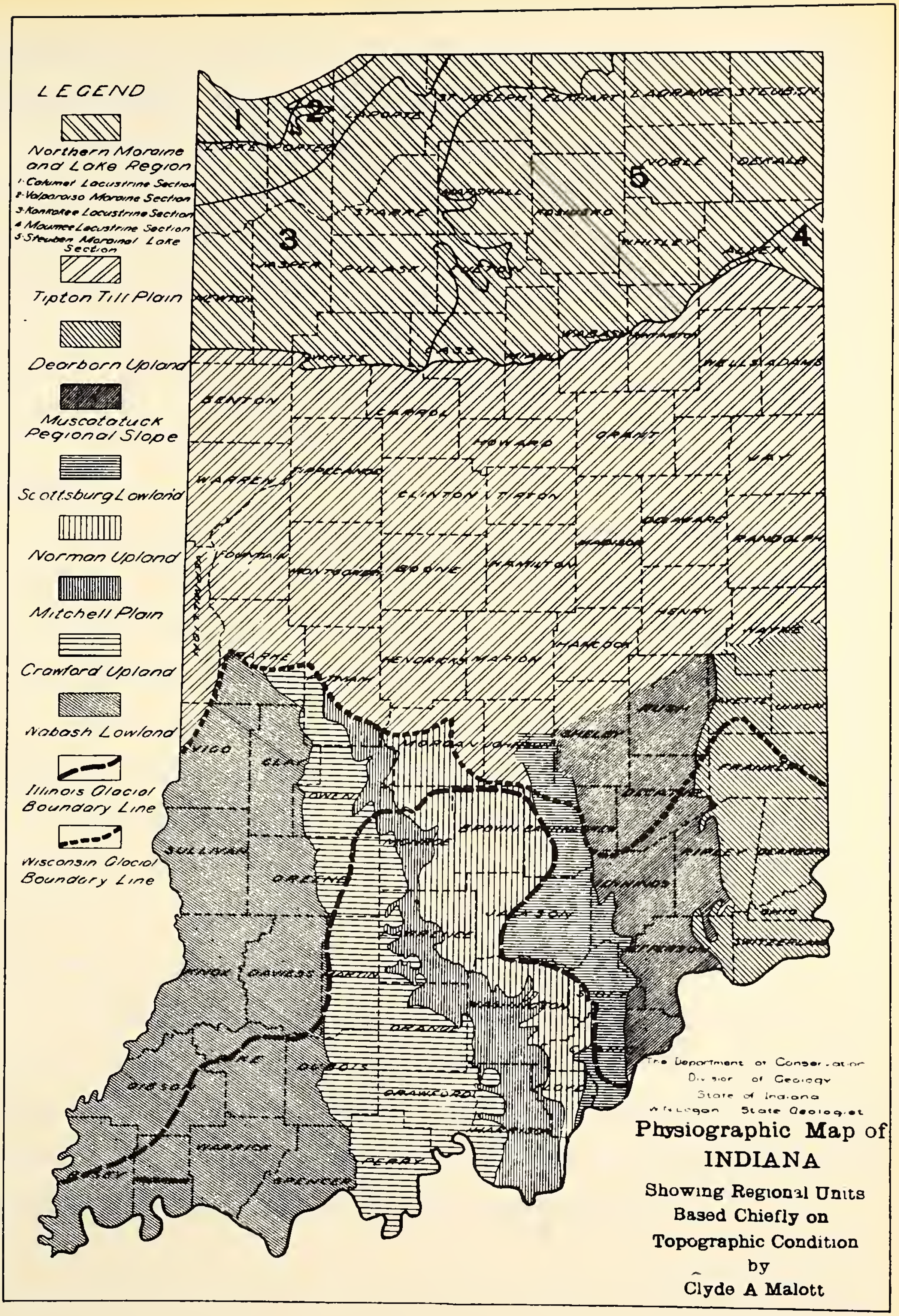

LEGEND
Northern Moraine and Lake Region
1-Calumet Lacustrine Section
2-Valparaiso Moraine Section
3-Kankakee Lacustrine Section
4-Maumee Lacustrine Section
5-Steuben Morainal Lake Section
Tipton Till Plain
Dearborn Upland
Muscatatuck Regional Slope
Scottsburg Lowland
Norman Upland
Mitchell Plain
Crawford Upland
Wabash Lowland
Illinois Glacial Boundary Line
Wisconsin Glacial Boundary Line
The Department of Conservation
Division of Geology
State of Indiana
W. N. Logan State Geologist
Physiographic Map of
INDIANA
Showing Regional Units
Based Chiefly on
Topographic Condition
by
Clyde A Malott

FIG. 4

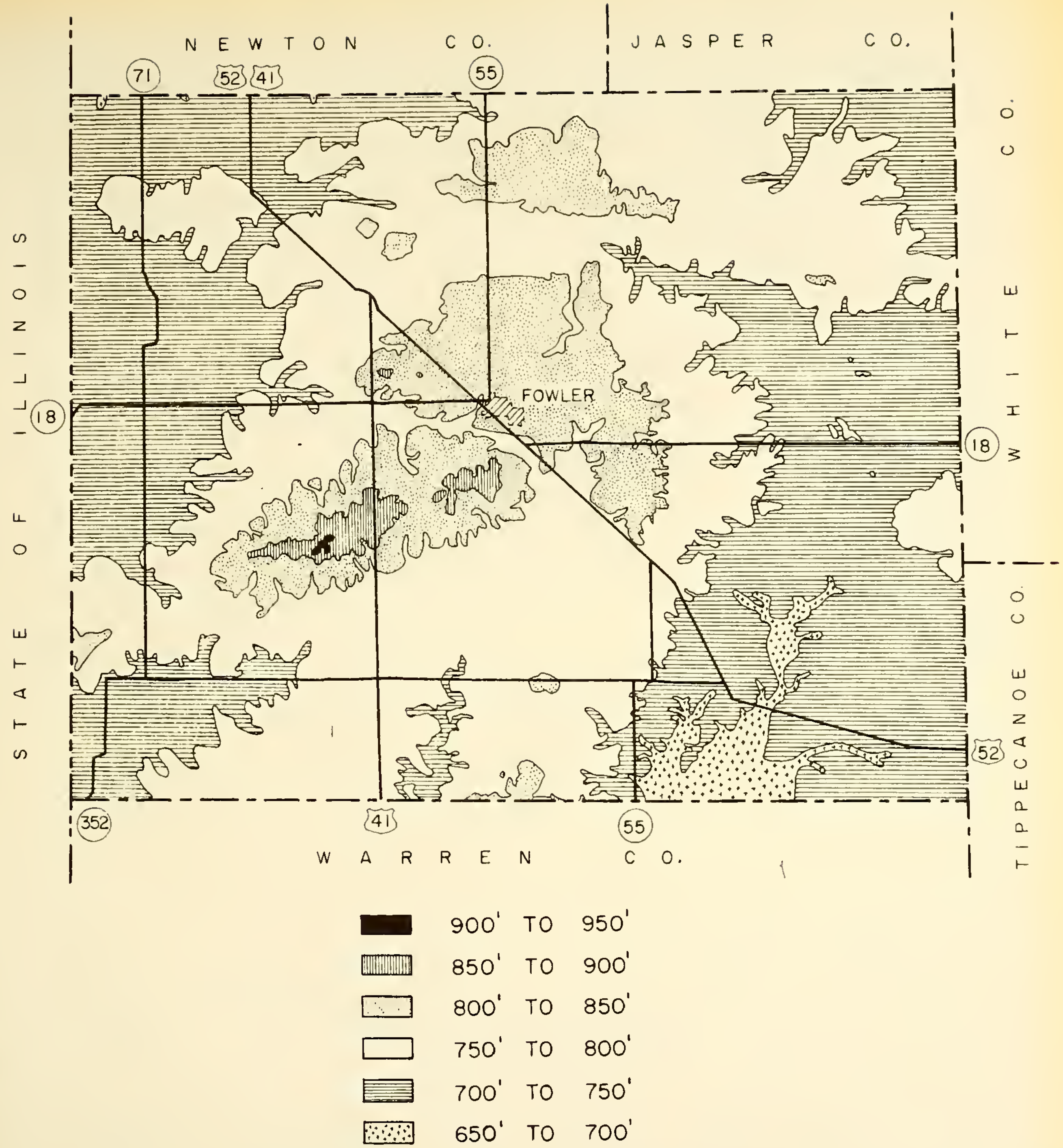
ridges that cross the central and southern parts belong to the Bloomington Morainic System; they are more or less jumbled clusters of small knolls.

As a whole, the central portion of Benton County is higher than the areas east and west of the county (See Fig.5). The highest elevation of 915 feet lies about five miles east of Dunnington. The lowest point (below 670 feet) of Benton County is located at the Big Pine Creek along the County line with Warren County. The average altitude of Benton County is about 740 feet (7). The maximum local relief is about 70 feet along the valley of Mud Pine Creek near Warren County.

Geology

Nearly all of Benton County is covered by Wisconsin glacial drift. Well records show that the glacial drift ranges from 25 feet to about 80 feet in the northern half of the county and over 400 feet in the south central section (8,9). The great variations are due to the presence of the buried Teays River and its tributaries. The Teays Valley enters southern Benton County from the southeast. Almost immediately it turns westward and follows a course parallel to the Benton-Warren County line before entering Illinois (See Fig.6)(9, 10). The glacial drift is classified as the Catersburg Till Member of the Trafalgar Formation and a small portion of the surface material along Sugar Creek is considered as outwash facies of the Atherton Formation by Wayne(11).

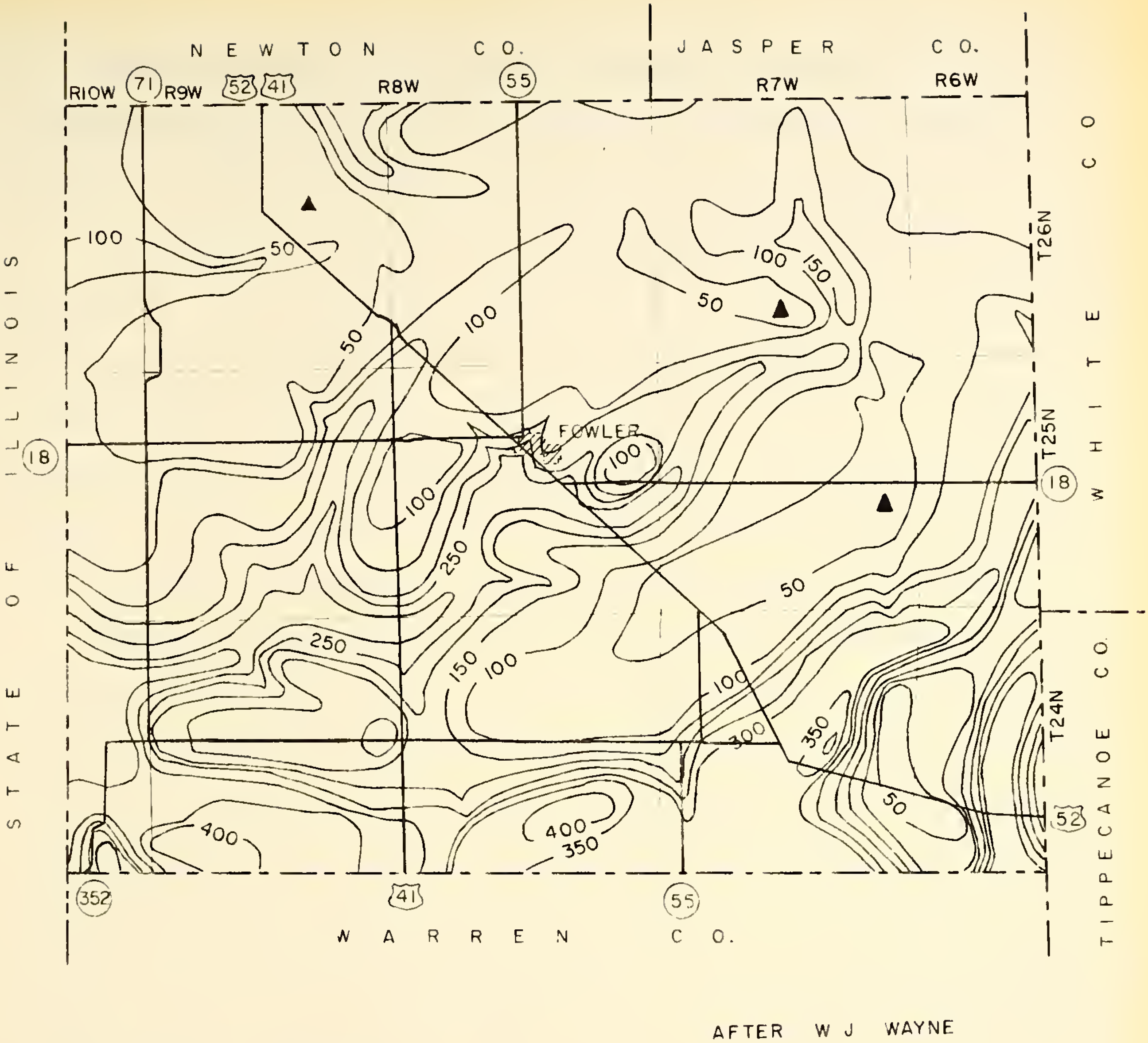
There are three moraine ridges in Benton County. The northern one is called the Nebo-Gilboa ridge. This ridge is named for two of its prominent knolls, Mount Nebo and Mount Gilboa. They are kames (about 50 feet in height) within the gently undulating moraine. This ridge is the divide between the Kankakakee and Wabash drainage basins in Benton County (12).



DERIVED FROM THE DANVILLE (NK 16-11) NATIONAL TOPOGRAPHIC 1° QUADRANGLES, SCALE 1/250,000

FIG. 5 TOPOGRAPHIC MAP OF BENTON COUNTY

(CONTOUR INTERVAL 50')



▲ ROCK EXPOSURE

(CONTOUR INTERVAL 50 FEET)

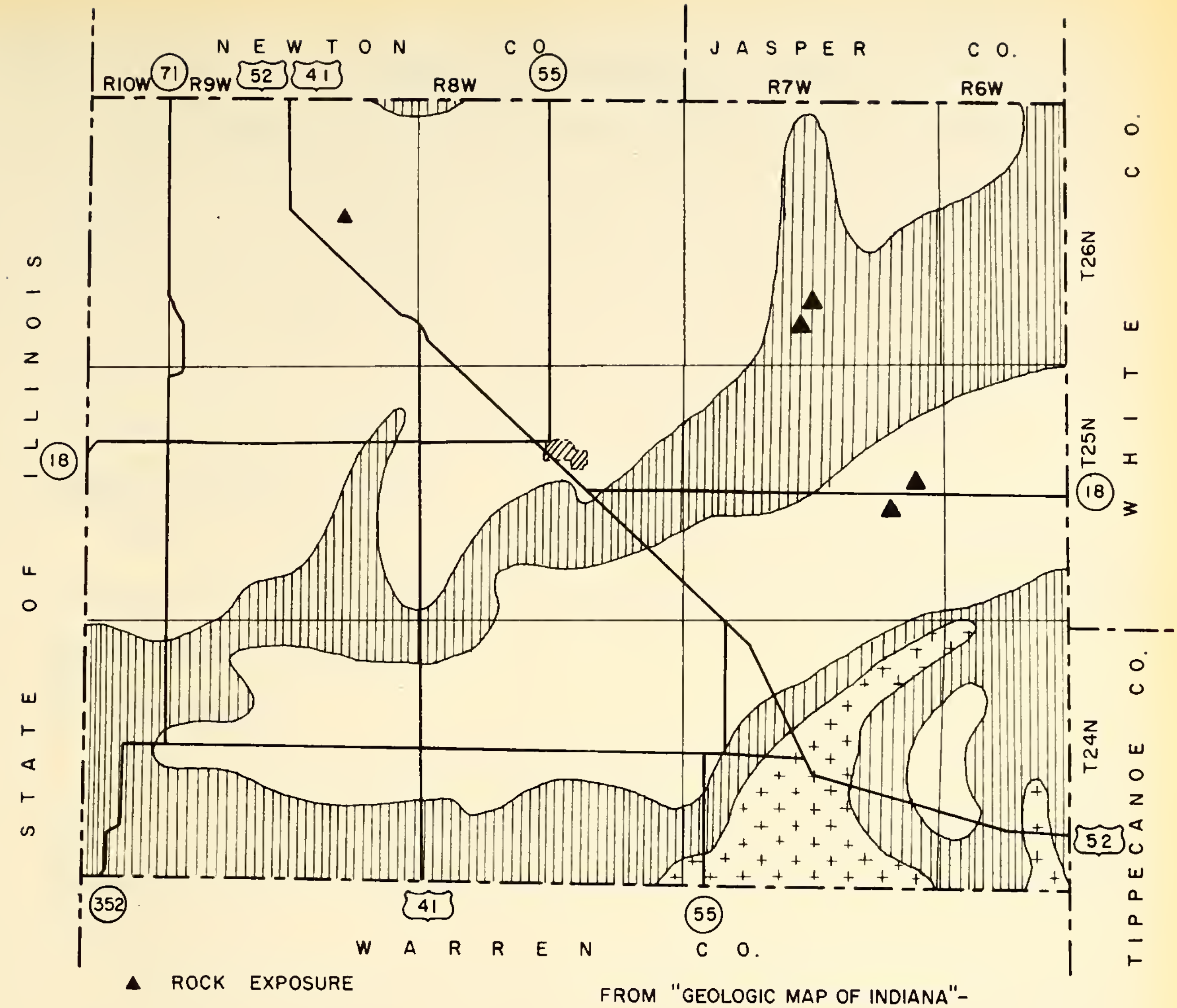
SCALE: 1/250,000

FIG. 6 THICKNESS OF GLACIAL DRIFT IN BENTON COUNTY, INDIANA.

The southern part of the county is covered by the glacial drift of the Bloomington Morainic System. This presents a jumbled series of moraines. There are clusters of small hills in the gently undulating plains.

The bedrock strata beneath the glacial material in Benton County contain formations of Mississippian and Devonian periods. More than half of the county is underlain by bedrock of the Osagian and Kinderhookian Series of the Mississippian period (See Fig.7). New Albany and Antrim Shales of the upper Devonian and lower Mississippian periods occupy about one third of Benton County. The oldest rock strata of the middle Devonian limestone, dolomite and sandstone are encountered in the southeastern quarter of the county.

There are a few rock exposures in Benton County. Among them there are three small limestone quarries. One is located in Sec. 24, T. 25 N., R. 7 W. in the valley of Big Pine Creek. Another is located in Sec. 14, T. 26 N., R. 9 W. in the valley of Sugar Creek, one mile north of Earl Park. Both of the limestone exposures (Keokuk limestone) are thinly bedded, soft and shaley on top but cherty and concretionary with depth (13). A better quality limestone (called St. Louis limestone by Gosby) has been quarried in the valley of Big Pine Creek in Sec. 28, T. 26 N., R. 7 W. This stone is evenly bedded in ledges of three to four inches in thickness (13).



FROM "GEOLOGIC MAP OF INDIANA"- GEOLOGICAL SURVEY.

OSAGIAN AND KINDERHOOKIAN SERIES - MISSISSIPPIAN

NEW ALBANY AND ANTRIM SHALES - DEVONIAN - MISSISSIPPIAN

MIDDLE DEVONIAN LIMESTONE, DOLOMITE & SANDSTONE - DEVONIAN

SCALE : 1/250,000

FIG. 7 GEOLOGIC MAP OF BENTON COUNTY.

LAND FORMS AND ENGINEERING SOIL AREAS

The engineering soils in Benton County are derived from unconsolidated materials. The unconsolidated materials include glacial deposits, glacial-fluvial deposits, alluvial deposit, eolian deposits and cumulose deposits.

Since the deposits of transported materials are far from homogenous, variation should be expected. General properties and profile of the soil for each area of different landform are presented in this report.

GLACIAL DEPOSITED MATERIALS

The major portion of Benton County is covered by glacial deposits of Wisconsin Age. The landforms of this glacial deposit include ridge moraine, ground moraine and kame.

1. Ridge Moraine

Three morainic ridges are identified in Benton County. They trend east-west. The northern one (Nebo-Gilboa ridge) marks the outer border of the late Wisconsin lobes (Fig.8). The other morainic ridges belong to the Bloomington Morainic System,

The texture of the ridge moraine varies greatly from one place to the other. They are subdivided into three groups namely: granular-textured ridge moraine, sandy-textured ridge moraine and medium-textured ridge moraine.

(A) Granular-Textured Moraine

Only limited areas in Benton County are recognized as granular-textured ridge moraine. The larger area is around Mount Gilboa in the northeastern quarter of the county. The other sizable area lies near Gravel Hill about three miles northwest of Fowler. A few smaller patches are scattered along Big Pine Creek Ditch.


MORAINES of WISCONSIN GLACIAL STAGE
Moraines of Shelbyville Subsatge
Moraines of Champaign Substage
Moraines of Bloomington Substage
Moraines, Saginaw Lobe Late Wisconsin Substage
Moraines of Erie Lobe Late Wisconsin Substage
Moraines of Lake Michigan Lobe Late Wisconsin Substage
Former Glacial Lakes Along Driftless Margin
Glacial Waterways Through Driftless Areas
Glacial Map of Indiana
Showing Glacial Boundary with Glacial Lakes within the Driftless Area due to ponded Drainage along the Drift Margin and Morainic Masses of the Chief Substages of Wisconsin Glacial Stage. Note Differentiated Morainic Masses of the Erie, Saginaw and Lake Michigan Lobes of the Late Wisconsin Substage.
— by —
C A Malott
The Department of Conservation
Division of Geology
State of Indiana
W N Logan State Geologist
Illinoian Drift-Covered Area
Western Section
Illinoian Drift-Covered Area
Eastern Section
DRIFTLESS AREA
Marseilles Moraine
Valparaiso Moraine
BLOOMINGTON MORAINIC SYSTEM
CHAMPAIGN MORAINIC SYSTEM
SHELBYVILLE MORAINIC SYSTEM
Outer Border of Late Wisconsin Drift
Union City Moraine
Glacial Boundary
LAPORTE
ST JOSEPH
LAGRANGE
STEUBEN
NOBLE
DEKALB
MARSHALL
STARKE
KOSCIUSKO
JASPER
PULASKI
WHITLEY
ALLEN
NEWTON
WHITE
MIAMI
WABASH
HUNTINGTON
WELLS
ADAMS
BENTON
CARROLL
GRANT
HOWARD
TIPPECANOE
CLINTON
TIPTON
DELAWARE
MADISON
FOUNTAIN
BOONE
HAMILTON
HENDRICKS
HANCOCK
WAYNE
UNION
SHELBY
FRANKLIN
VIGO
CLAY
OWEN
MORGAN
DECATUR
SULLIVAN
GREENE
MONROE
BROWN
BARTHOLOMEW
JENNINGS
RIPLEY
DEARBORN
OHIO
SWITZERLAND
JEFFERSON
JACKSON
LAWRENCE
KNOX
DAVIESS
MARTIN
SCOTT
WASHINGTON
ORANGE
CLARK
PIKE
GIBSON
DUBOIS
FLOYD
CRAWFORD
HARRISON
WARRICK
PERRY
POSEY
VANDERBURG
SPENCER

FIG. 8

Hilly topography (local relief of more than 50 feet) is found in these areas except those along the Big Pine Creek Ditch where more subdued topography prevail. A surface drainage system is absent in this region because of the porous texture of the deposit.

The surface soil of this region varies from sand or sandy loam (A-2-4) in the high position to high organic content silty clay or clay (A-6 or A-7) in the depression. The B horizon has a higher clay content than the surface soil and the texture ranges from sandy loam to sandy clay loam to clay. Stratified gravel and sand may be found in the C-Horizon, otherwise, clay loam and clay (A-4, and A-6) are not uncommon. A number of gravel pits occur in this area as shown on the soils map.

(B) Sandy-Textured Ridge Moraine

About 15 square miles of land in Benton County is classified as sandy-textured ridge moraine. The largest concentration of this deposit is located in the southwestern quarter of the county. Other smaller areas are scattered in the eastern half of the county.

The topography is generally undulating with occassionally rolling landscape. Infiltration basins are numerous in this region. Therefore surface drainage is poorly developed or absent.

The surface soil varies from sandy loam to loam in the high position to an organic rich silty clay loam or clay in the depressions. The subsoil ranges from sandy clay loam to clay. The parent material is generally sandy loam but clay loam and clay are found in many places.

(C) Medium-Textured Ridge Moraine

The majority of the morainic areas in Benton County belong to this category

Because of the vegetation difference this area is subdivided into timber region and prairie region.

(a) Medium-Textured Ridge Moraine-Timber Region

Only limited areas of Benton County fall in this category. The deposits occur mainly along Big Pine Creek and Mud Pine Creek. However, a few isolated areas are scattered in the southeastern part of the county in the vicinity of Oxford and about three miles north of Boswell.

These areas are easily identified on aerial photographs because of the presence of trees. Undulating to gently rolling topography dominate this region.

The A-horizon of this deposit ranges from silt loam to silty clay loam in the high to a silty clay or clay in the low position. Silty clay and clay soils are found in the B-horizon. The parent material is predominately clay loam or clay in texture.

(b) Medium-Textured Ridge Moraine-Prairie Region

The majority of the ridge moraine deposits in Benton County belong to this classification. The most extensive deposit lies in the southwestern quarter of the county the best morainic expression (rolling topography) is found in the area southwest of Fowler and in the vicinity of Earl Park. The remainder of this ridge deposit exhibits a very weak morainic expression. Undulating landscape predominates the main portion of this area. Surface drainage systems are not very well established.

The soil profile of this area consists of a shallow organic silty clay to clayey topsoil followed by a loam to clay subsoil and then the typical clay loam to clay glacial drift. The topsoil is classified as A-7-5, A-6 or A-4soil.

The B-horizon varies from A-4, A-6 to A-7-6 soil. The parent material is generally an A-4, soil.

2. Ground Moraine

More than half of Benton County is covered by ground moraine deposits. The most extensive deposit occurs in the northern part of the county. The topography of the ground moraine is nearly level except along the vicinity of drainage channels where dissected and undulating topography occurs. The ground moraine in the county can be subdivided into three groups. (A) the sandy-textured ground moraine, (B) the medium-textured ground moraine and (C) the loess covered, medium-textured ground moraine.

(A) Sandy-Textured Ground Moraine

The sandy-textured ground moraine deposits are mostly confined to the southern quarter of the county. However, scattered deposits are found near Fowler, in the vicinity of Freeland Park and near the eastern county border about three miles both north and south of Big Pine Creek.

The topography of the sandy textured ground moraine is slightly more undulating than the other ground morainic areas. Surface drainage is absent in this region because of its interior drainage characteristic. However, a number of depressional basins exist especially in the areas located in the southwestern quarter of the county.

The soil profile of this region is essentially the same as the sandy-textured ridge moraine previously discussed. The difference is in the A-horizon where thicker and slightly less sandy surface soil are found in the ground moraine deposits.

(B) Medium-Textured Ground Moraine

The majority of the ground moraine deposits fall in this category. The nearly level topography dominates this region except in the vicinity of drainage

channels where undulating landscape occurs. Natural surface drainage is not very well developed because of its near level topography. However, gullies and ditches occur on these medium textured deposits. Because of the vegetational effect the soils of this deposit are subdivided into (a) prairie region and (b) timber region.

(a) Medium Textured Ground Moraine, Prairie Region

Nearly all of the medium textured ground moraine in Benton County is under the influence of the prairie vegetation. The airphotos reveal the high organic content of the surface layer by a dark tonality.

The surface soil varies from an organic silty clay loam to organic clay. Soil boring data (see appendix) shows that the texture of the A-horizon falls into the A-4, A-6 and A-7-6 categories. The B-horizon ranges from clay loam to clay (A-4 to A-6). The parent materials are either a loam, a clay loam or clay (A-4 to A-6 soil).

Within the flat ground morainic region, a number of slightly higher knolls can be recognized by their lighter photo tonality. These island like knolls are irregular in shape and scattered exclusively in the northern part of the county. A silt textured symbol is used to differentiate these areas.

The soil profile shows less organic matter and are more sandy and silty in texture than the surrounding lower area. The B-horizon is silty clay to clay in texture. The parent material is essentially the same as the rest of the region. However, sandy loam soil may be found in places.

(b) Medium-Textured Ground Moraine, Timber Region

Most of the medium-textured ground moraine developed under timber is confined to the valley walls and the adjacent upland along Big Pine Creek. A narrow strip

is found along the valley walls of Mud Pine Creek. These areas are easily identified by the presence of trees.

The top layer of the soil profile varies from silt loam to clay in texture. The B-horizon is a plastic silty clay or clay. The parent material is classified as clay loam or clayey glacial drift.

(c) Loess Covered, Medium Textured Ground Moraine

At the extreme southeastern corner of Benton County lies a small deposit recognized as loess covered, medium textured ground moraine. Very gently undulating topography is found in this area. The region is under the influence of prairie vegetation. However, the photography of this area shows a slightly lighter tone than the adjacent medium textured ground moraine area.

The loess cover in this area varies in depth from about 18 to 36 inches. The soil profile is characterized by an organic silt loam to silty clay topsoil, a silty clay to clay subsoil and generally a clay loam parent material. Test site No. 3 in Tippecanoe County may be used as the representative soil sample of this area (14). The A-horizon taken from 2 to 10 inches below the surface is an A-5 soil. The B horizon taken from 15 to 26 inches is classified as A-6(9) soil. The parent material taken from a depth of 50 to 66 inches is identified as an A-4(8) soil.

(3) Kames

There are a number of kames in Benton County. Most of them are concentrated in the granular textured ridge moraine region and are mapped as a single unit with in the granular textured ridge moraine. Two isolated kames located about one and one half miles east of Swanington are identified on the airphotos.

The soil developed on kames varies considerably. Due to the different degree of erosion and the origin of deposition, the A-horizon varies greatly

in both texture and in thickness. Loam, clay loam, silt loam or silty clay loam may be found in the surface layer. In areas of severe erosion the surface soil may be entirely removed and the subsoil is exposed. The subsoil varies from sandy clay to clay. The amount of sand and gravel increases with depth. Clean stratified sands and gravels are found in the parent material zone. This stratified, coarse material disappears rapidly from the base of the kame and marges with the glacial till in the surrounding areas.

(4) Boulder Belt

Three boulder belts are recognized in Benton County. The largest one lies in the southeastern quarter is called the Fowler-Lafayette boulder belt. Another one is located west of Fowler. The third and the narrowest one occured southwest of Boswell, and is an extension of a narrow boulder belt from Williamsport in Warren County.

Owing to the intensive farming and clearing activities in the county a great number of the boulders that were strewn over the surface have been removed, therefore, the exact position of the belt cannot be determined. The outline of the belt on the attached engineering soils map is based on the literature (8) and field checks. Most of the boulders are about a foot or two in diameter.

FLUVIAL DEPOSITED MATERIALS

Only a small percentage of land in Benton County is covered by fluvial deposited materials. Five different landforms created by the action of water, namely: outwash plain, terrace, valley train, lacustrine plain and alluvial plain are discussed as follows:

1. Outwash Plains

There are two outwash plains in Benton County. The larger one is located at the confluence of Sugar Creek and Mud Creek. The other small area lies about

one mile north of Ambia. Due to the difference in texture they are discussed under the following subheadings: gravelly outwash plain and sandy outwash plain.

(A) Gravelly Outwash Plain

The gravelly outwash deposit is the larger outwash plain in the county. It is about five square miles in area. The main body of the plain lies south of Sugar Creek and Mud Creek. The plain is extremely flat sloping very gently toward the west. The typical infiltration basins and current scars of outwash plain are found near the channel of Sugar Creek. It is likely that coarser textured deposits may be found toward the drainage channel and finer material toward the edges of the outwash plain.

The A-horizon of the soil profile varies from loam in the high position to organic silty clay loam in the low area. The B-horizon subsoils are either silty clay or clay. The amount of sand and gravel increases with depth in the profile and stratified sands and gravels are encountered at depth of 36 to 78 inches.

(B) Sandy Outwash Plain

The area recognized as sandy outwash plain is about one quarter of a square mile in area located on the southwestern corner of Benton County. This sandy outwash plain is topographically low. The surface is nearly level and without surface drainage development. Both current scars and infiltration basins are absent in this region.

The top soil which contains considerable organic materials is either a silt loam or silty clay loam in texture. The B-horizon is a silty clay or clay soil. Sandy clay loam or clay loam may be found in the lower B horizon. Stratified sand is found from about three feet to six feet from the surface. Some gravel and silt strata may be interbedded with the stratified sand in the profile.

2. Terraces

A few terraces are recognized in Benton County. Due to texture, they are subdivided into gravelly-textured and silty-textured terraces.

(A) Gravelly-Textured Terraces

The gravelly-textured terraces are confined mainly along the Big Pine Creek. The largest area is located near the Warren County border. The rest are generally narrow flat terraces. However, with infiltration basins undulating landscape occur here and there. A surface drainage system is absent in this region. The surface of the terrace along Mud Pine Creek is modified to a considerable extent by wind blown sand deposits.

The surface soil of the terrace varies greatly from place to place. It ranges from a sandy loam to a silty clay loam. The subsoil also varies accordingly from a sandy clay loam to clay. Usually a gravelly clay loam is found in the lower profile before the stratified sand and gravel strata is reached.

(B) Silty-Textured Terrace

A narrow strip along Sugar Creek just north of Earl Park falls into the silty-textured terrace category. There are no infiltration basins on this flat terrace. Many surface drainage channels have developed across the terrace and give an indication of the silty texture of this deposit.

The soil profile in this region consist of a silty clay loam or silty clay topsoil, a silty clay or clay subsoil and a stratified sand and silt or sand with some gravel parent materials. Test site No. 48 is located at the edge of the terrace. At a depth of 3.5 to 6.0 feet, the soil is classified as gravelly sandy loam (A-1-b) soil. It contains 29% of gravel, 47% of sand, 13% of silt and 11% of clay.

3. Valley Train (Valley Fill)

An area northwest of Earl Park and on the north bank of Sugar Creek is designated as valley train deposit. This deposit was formed by the abandoned glacial sluiceway. The sluiceway was cut and backfilled by the latest glacial melt waters. The valley train in Benton County has a gently saucer shaped cross section. No significant deposit of recent alluvium and no stream crosses this valley train deposit.

The soil profile shows the top soil is of either an organic silty clay or organic clay. The organic matter decreases with depth and a silty clay or clay subsoil occurs. Clay loam or sandy loam may be found before the loose sand and gravel valley fill material is reached.

Test site Nos. 50 and 51 are located in this region. The A-horizon taken from the surface to a depth of one foot is clayey in texture and classified as A-6(7) soil. From one to two feet below the surface a plastic clay, A-7-6(18), soil is found. Loam and sandy loam were encountered further down. The loose gravelly sand classified as A-1-b soil is reached at a depth of four feet from the surface.

4. Lacustine Plains

Two lacustrine plains are recognized in Benton County. The larger one is located at the head water of both Sugar Creek and the western branch of Big Pine Creek just west of Wadena. The other lies north of Ambia near the southwestern corner of the county.

The topography is a flat basin surrounded by higher ground. Dark photo tonality is exhibited in these areas. Ditches are constructed to drain these areas.

The soil profile generally consists of a dark gray highly organic silty clay to clay topsoil over a plastic clay subsoil. The parent material is clay with thin lenses of sand and silt or a clay loam texture.

5. Alluvial Plains

All drainage channels in Benton County possess recent alluvial plains or flood plains. However, the extent of mapping of these plains was determined by the scale of the engineering soils map.

The longest alluvial plain is associated with Big Pine Creek. Sugar Creek and Mud Pine Creek also exhibit large alluvial plains. Most of the alluvial plains have flat to near level surfaces. The featureless surface of the alluvial plain is broken by meandering streams or ditches.

The texture of the alluvial deposits varies greatly both horizonally and vertically from one place to the other. Coarser textural deposits are generally located near the stream channels. Finer materials are more prominant toward the valley wall or upland.

Test site #49 located on the flood plain of Sugar Creek has a silty clay (A-7-6) textural subsoil taken from (0.8 to 3.0 feet from the surface) and a sand and gravel (A-1-b) deposit below 4.5 feet.

EOLIAN DEPOSITED MATERIAL

Only limited eolian deposits are recognized in Benton County. The eolian deposits are subdivided into two groups; loess mantle deposits and sand dune deposits.

Most of the surface of the county is covered by a thin mantle of loess. Since the mantle is rather uniform and comparatively thin, only the top part of

the soil profile is subject to its influence. Therefore the thin loess mantle is not treated separately but included with the glacial landforms. In the extreme southeastern corner where the loess mantle reaches to a depth of 18 to 36 inches, the area is mapped as loess covered, medium textured ground moraine as discussed previously.

Sand Dunes

The sand dune deposits in Benton County are concentrated in the north-eastern corner of the county. They stretch across the ground morainic area in a linear ridge form. The ridge is narrow and low and merges with the ground moraine in a number of places. Another dune area is located about three miles north of Otterbein. Four dunes can be recognized in that area. The dunes are low ridges. At the lower portion of Mud Pine Creek a sand dune formation may be detected on the airphoto. The sand deposit in this area is thin and has an undulating topography. Because the area is small and primary a terrace deposit, it is mapped as terrace deposit as mentioned previously. A sand dune symbol however is used to identify the presence of dunes in that area.

The surface of the soil profile may contain some organic matter in the low areas. It is generally either a sand or a sandy loam in texture. The B and C horizons are sand throughout. If the sand deposit is thin than clay loam or sandy clay loam glacial drift material may be encountered at a depth below two feet from the surface.

CUMULOSE MATERIALS

Accumulations of organic materials occur frequently on the various land-forms previously described. In the depressions, highly organic topsoils may occur that would influence engineering decisions. Also, accumulation of

clayey topsoil in the depressions or basins may occur. These cumulose deposits are indicated on the map and discussed as follows:

1. Peat and Muck Basins.

Cumulose deposits of muck and peat occur in a number of basins randomly scattered in Benton County. The two larger ones are located near the upper end of Big Pine Creek and the other lies west of Fowler.

Most of the peats are derived from mosses, sedges and wood. In some basins a soft layer of marl may be found under about 12 to 42 inches of muck. The marl is an earthly material composed principally of an amorphous form of calcium carbonate. Since it is also undesirable from the engineering standpoint, no separation is made from the peat and muck in the soil profile illustrated. The depth of these cumulose deposits varies greatly from one location to another, therefore field investigation of each individual deposit is required.

2. Highly Organic Topsoil Depression

Depressed areas, where external and internal drainage is somewhat retarded give rise to the accumulation of organic topsoil. A number of such deposits occur in Benton County. Most of them are concentrated in the southeastern portion of the county. The largest one borders a muck and peat basin located in Sec. 32 and 33 of T. 26 N., R. 6 W.

The soil profile consists of an organic silty clay or clay topsoil, a plastic silty clay or clay subsoil and a loam, clay loam or clay parent material.

3. Clay Depression

In Benton County there are some shallow depressions showing a dark photo tonality that are not organic materials but accumulations of clay. These soils are generally associated with the high organic topsoil deposits. The clay soil

is very difficult to differentiate from the highly organic topsoil area by airphoto interpretation techniques because both show a relatively dark gray tone. Field checks are therefore necessary for thier identification.

The surface layer of the soil profile has a silty clay to clay texture. A more plastic clayey subsoil is found in the lower horizons. The loam to clay glacial drift material may be found below a depth of four feet from the surface.

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APPENDIX

Soil Boring Data Along US 52 North of Fowler

The soil test data tabulated below was taken from consultants reports to the Indiana State Highway Commission. Site numbers listed below correspond to numbered site locations along US 52 and a small section of US 41 shown on the attached engineering soils map. Only the sites referred to in the text has test data tabulated. Considerable additional data can be obtained from the consultants reports. (15, 16, 17).

SITE	STATION	OFFSET (FT.)	DEPTH (FT.)	AASHO CLASS.	TEXTURE	PERCENT				LL	PI
						GRAVEL	SAND	SILT	CLAY		
1	1592+00	37R B	0.5-2.0	A-7-6(10)	clay	0	13	45	42	41	15
2	1597+00	37R B	2.2-4.0	A-4(8)	silty clay loam	0	17	58	25	23	6
3	1602+00	37R"B"	0.0-1.2	A-7-5(6)	clay	0	42	11	47	44	11
4	1607+00	37R B	0.4-2.8	A-4(8)	silty clay loam	5	9	61	25	25	7
			2.8-4.6	A-2-4(0)	sandy loam	1	66	22	11	NP	NP
			4.6-6.0	A-4(3)	sandy loam	12	40	32	16	16	1
5	1611+00	37R B	4.6-6.0	A-4(4)	clay loam	13	34	25	28	23	8
6	35+00	37R B	2.4-4.5	A-7-6(19)	silty clay	0	2	53	45	53	31
7	46+00	37R B	1.0-2.4	A-7-6(16)	clay	0	4	42	54	49	25
			4.5-6.0	A-6(10)	silty clay	0	2	59	39	33	14
8	54+00	37R B	2.5-4.6	A-6(5)	clay	6	34	27	33	29	11
9	68+00	37R B	1.2-2.5	A-7-6(14)	clay	0	17	39	44	45	23
10	82+30	37R B	0.0-1.0	A-7-6(12)	clay	2	18	40	40	45	18
			4.4-6.0	A-2-4(0)	gravelly sandy loam	21	55	14	10	NP	NP
11	91+00	37R B	4.2-6.0	A-4(8)	silty clay loam	0	17	61	22	21	3
12	102+00	37R"B"	0.4-2.0	A-6(10)	clay	2	11	45	42	39	15
			2.0-4.0	A-6(8)	clay	3	28	32	37	29	12

13	106+00	37R"B"	0.0-1.8	A-7-5(13)	clay	0	13	39	48	49	17
			1.8-4.0	A-6(7)	clay	3	31	30	36	28	11
14	110+00	37R B	0.0-0.6	A-4(2)	sandy loam	1	54	26	19	18	3
			0.6-1.8	A-4(3)	sandy clay loam	0	51	22	27	22	5
			1.8-4.5	A-2-4(10)	sand	0	85	2	13	NP	NP
15	116+50	37R"B"	2.5-4.5	A-7-6(14)	clay	0	2	47	51	47	21
			4.5-6.0	A-6(11)	clay	2	15	45	38	37	18
16	123+00	37R B	4.2-6.0	A-4(5)	clay loam	9	33	32	26	23	8
17	131+00	37R"B"	7.2-8.8	A-3	sand	0	90	4	6	NP	NP
18	143+60	37R"B"	2.4-4.0	A-6(7)	clay	3	31	29	37	29	12
19	149+00	37R"B"	2.2-3.6	A-4(2)	sandy clay loam	7	49	23	21	18	5
20	151+50	37R B	1.5-4.5	A-1-6(0)	gravelly sand	29	57	2	12	NP	NP
21	168+00	E GRPR	1.8-4.8	A-7-6(11)	silty clay	0	1	55	44	45	16
22	182+00	E GRPR	2.8-5.0	A-7-6(14)	clay	0	4	45	51	48	20
23	190+00	E GRPR	8.0-10.0	A-6(6)	clay loam	5	32	41	22	25	11
24	483+00	37R 41	0.0-2.0	A-6(9)	clay	2	24	41	33	37	14
			4.2-6.0	A-4(6)	clay	1	36	32	31	25	9
25	492+00	E 41PR	1.4-2.4	A-6(8)	clay	1	31	31	37	39	14
			4.6-6.0	A-4(1)	sandy loam	10	49	27	14	NP	NP
26	499+00	E 41PR	3.5-5.5	A-4(2)	sandy loam	5	50	32	13	NP	NP
27	504+50	E 41PR	5.5-7.5	A-6(9)	silty clay	0	9	50	41	31	12
			10.0-13.0	A-4(8)	silty clay	0	3	53	44	28	10

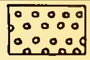
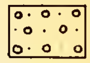
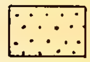
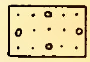
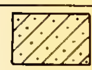
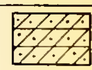
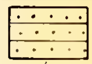
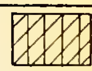
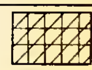
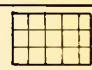
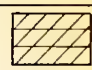
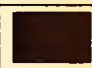
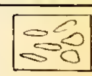
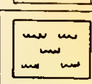
28	515+00	℄ 41PR	1.8-4.0	A-6(9)	clay	3	28	32	37	40	16
			4.0-5.8	A-6(6)	clay	3	31	36	30	29	11
29	525+00	℄ 41PR	0.0-0.8	A-7-5(8)	clay	1	16	48	35	41	11
30	197+00	℄ GRPR	3.5-5.0	A-6(6)	clay	2	31	33	34	30	11
31	532+00	℄ 41PR	4.5-6.0	A-4(6)	clay	4	31	34	31	25	9
32	210+15	37L"G"	0.0-2.1	A-6(10)	clay	1	14	46	39	40	14
			2.1-4.2	A-7-6(17)	clay	0	3	40	57	55	26
			4.2-6.0	A-4(7)	clay	2	29	38	31	26	9
33	222+50	37L"G"	3.5-4.2	A-4(6)	clay loam	4	30	36	30	35	10
			4.2-6.0	A-2-4(0)	gravelly sandy loam	24	43	19	14	26	7
34	228+00	37R G	2.1-4.0	A-6(6)	clay loam	11	36	24	29	35	17
			4.0-6.0	A-4(3)	clay loam	6	42	28	24	28	10
35	234+00	37L"G"	0.0-1.0	A-4(8)	clay	1	25	42	32	30	7
36	257+00	37R"G"	0.0-1.6	A-6(10)	clay	2	24	35	39	39	16
			1.6-2.4	A-6(9)	clay	4	32	24	40	38	10
			2.4-4.1	A-4(6)	clay loam	3	31	41	25	22	6
			9.1-12.3	A-2-4(0)	gravelly sandy loam	24	48	13	15	16	3
			12.3-14.0	A-4(4)	clay loam	11	36	31	22	16	2
37	262+80	37L"G"	5.0-6.0	A-4(4)	loam	3	41	36	20	24	7
38	269+00	37R"G"	1.3-4.3	A-4(4)	clay loam	4	42	27	27	24	8
39	281+30	37R"G"	4.0-6.0	A-4(5)	clay loam	3	38	32	27	23	8
40	305+00	37L"G"	2.5-3.6	A-4(6)	loam	2	35	46	17	20	4
			5.5-8.5	A-4(6)	clay loam	6	31	33	30	20	8
41	321+30	37R"G"	0.0-0.5	A-7-6(10)	clay	1	13	43	43	42	14

			0.5-2.5	A-7-6(16)	clay	2	8	39	51	47	26
			4.0-7.0	A-4(5)	clay	8	30	30	32	24	8
42	326+00	37L"G"	3.5-7.5	A-4(8)	silty clay loam	2	15	62	21	19	2
43	332+00	37R"G"	4.0-7.0	A-4(5)	clay	8	30	30	32	24	8
44	339+00	37L G	0.0-0.8	A-4(8)	silty clay	0	19	51	30	39	9
45	351+00	37L"G"	5.0-6.0	A-4(5)	clay loam	4	34	32	30	25	10
46	358+50	37L"G"	1.0-2.5	A-7-6(13)	clay	0	5	32	63	44	20
			2.5-4.0	A-6(8)	clay	3	25	36	36	28	12
47	363+00	37R G	1.0-2.2	A-6(11)	clay	1	19	38	42	39	18
			4.0-6.5	A-4(1)	sandy clay loam	2	60	16	22	22	8
48	371+00	37L"G"	3.5-6.0	A-1-b(0)	gravelly sandy loam	29	47	13	11	NP	NP
49	382+60	37L"G"	0.8-3.0	A-7-6(16)	silty clay	0	12	51	37	50	25
50	392+00	37R G	4.0-6.0	A-4(2)	sandy loam	9	46	27	18	20	3
51	410+30	37R"G"	0.0-1.0	A-6(7)	clay	3	30	35	32	38	11
			1.0-2.0	A-7-6(18)	clay	0	6	39	55	54	28
			4.6-6.0	A-1-b(0)	gravelly sand	28	52	13	7	NP	NP
52	418+00	37L"G"	2.5-4.5	A-4(4)	clay loam	8	36	29	27	25	8
53	424+00	37R"G"	2.6-4.5	A-4(4)	clay loam	0	45	31	24	23	7
			4.5-6.0	A-2-4(0)	sand	0	82	8	10	NP	NP
54	432+00	37R"G"	0.0-1.2	A-7-5([illegible])	silty clay	1	12	56	31	44	12
			2.5-4.5	A-6(11)	clay	2	23	34	41	39	18
55	438+00	37L"G"	1.5-3.0	A-6(10)	clay	1	12	42	45	40	14

56	281+00	37L"B"	3.5-4.0	A-6(7)	clay	10	34	23	33	39	18
57	290+00	37L"B"	2.0-4.0	A-6(11)	clay	3	19	32	46	39	19
58	293+00	37L	0.0-1.0	A-7-6(10)	clay	0	16	44	40	42	13
			4.4-5.4	A-6(10)	silty clay	3	3	60	34	31	15
			5.4-6.0	A-4(5)	loam	1	38	45	16	NP	NP
59	299+00	37L	3.5-4.1	A-2-4(0)	sandy loam	14	63	11	12	NP	NP
60	305+00	37L	1.0-2.1	A-4(1)	sandy clay loam	4	55	17	24	25	6
61	311+00	37L	0.8-2.0	A-7-6(9)	clay	3	41	19	37	42	21
			2.0-3.5	A-6(7)	clay	3	28	38	31	27	11
62	317+00	37L	4.0-6.0	A-6(9)	clay	4	27	29	40	32	16
63	329+00	37L	2.4-4.4	A-4(1)	sandy loam	1	62	21	16	NP	NP
			4.4-6.0	A-4(3)	loam	10	39	34	17	17	2
64	331+00	37L	2.0-3.5	A-7-6(20)	clay	0	4	40	56	62	33
			3.5-6.0	A-6(10)	silty clay	1	16	50	33	34	15
65	335+00	37L	4.3-5.5	A-6(10)	clay	0	15	46	39	32	15
66	338+00	37L	0.0-0.9	A-6(9)	clay	0	18	49	33	38	13
			2.2-4.3	A-7-6(16)	clay	0	9	45	46	46	27
67	350+00	37L	1.0-2.0	A-7-6(11)	silty clay	0	5	50	43	41	16

APPENDEX B

SOIL CLASSIFICATION AND PROFILE SYMBOLS

Description	Grain Size Distribution: Gravel % Retained on #10	Sand #10–#200	Silt 0.05–0.005mm	Clay Less than 0.005mm	Plastic Index	Symbol
Gravel	85–100	0–15	0–10	0–10	NP	
Sandy Gravel	50–85	15–50	0–10	0–10	6 Max.	
Sand	0–15	85–100	0–10	0–10	NP	
Gravelly Sand	20–49	45–85	0–10	0–10	6 Max.	
Sandy Loam	0–19	50–80	0–50	0–20	6 Max.	
Sandy Clay Loam	0–19	50–80	0–30	20–30	10 Max.	
Sandy Clay	0–19	55–70	0–15	30–45	11 Min.	
Loam	0–19	30–50	30–50	0–20	10 Max.	
Silt Loam	0–19	0–50	50–100	0–20	10 Max.	
Silty Clay Loam	0–19	0–30	70–100	20–30	11 Min.	
Silty Clay	0–19	0–15	55–70	30–45	11 Min.	
Clay Loam	0–19	20–50	50–80	20–30	11 Min.	
Clay	0–19	0–55	0–55	30–100	11 Min.	
Peat or Muck						
Limestone						
Sandstone						
Shale						
Stony Fragments						
Organic Matter						
Topsoil						

Classification of Gravelly Soils

85%–100% gravel plus finer material – Gravel
50%–84% gravel plus finer material – Clayey, silty or sandy gravel
20%–49% gravel plus finer material – Use fine classification and called gravelly sand, gravelly silt or gravelly clay
0%–19% gravel plus finer material – Use fine classification only

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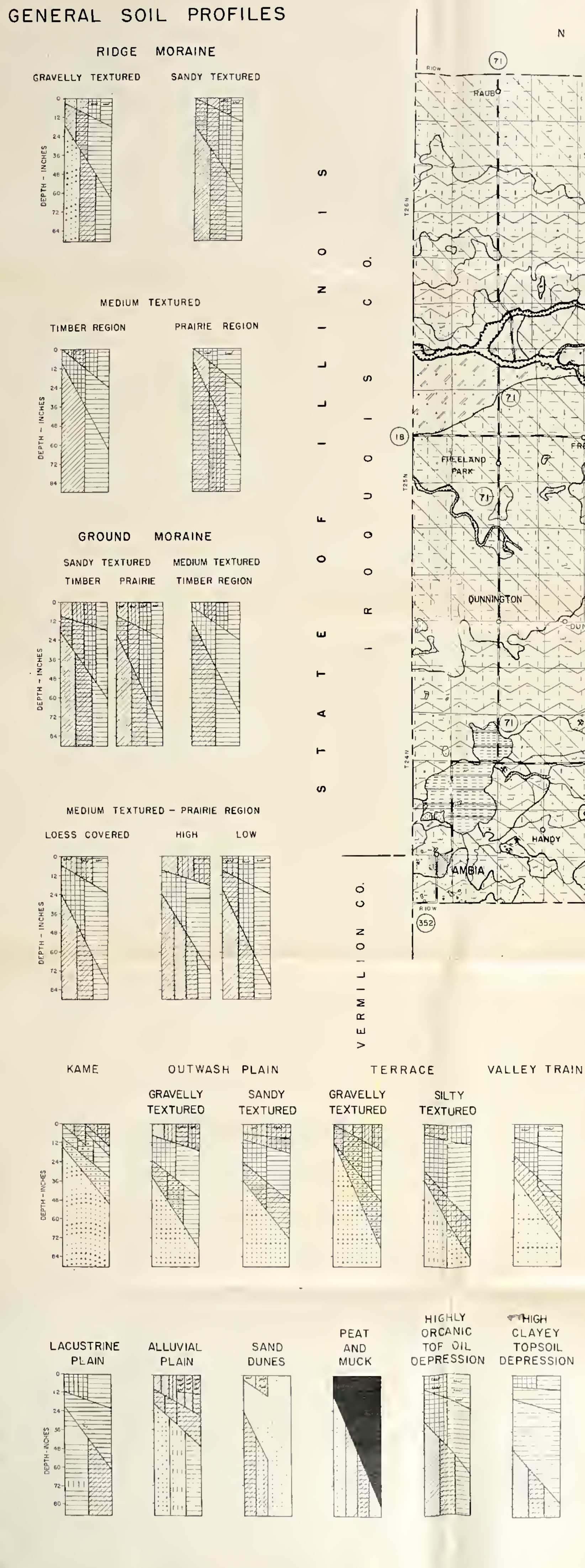
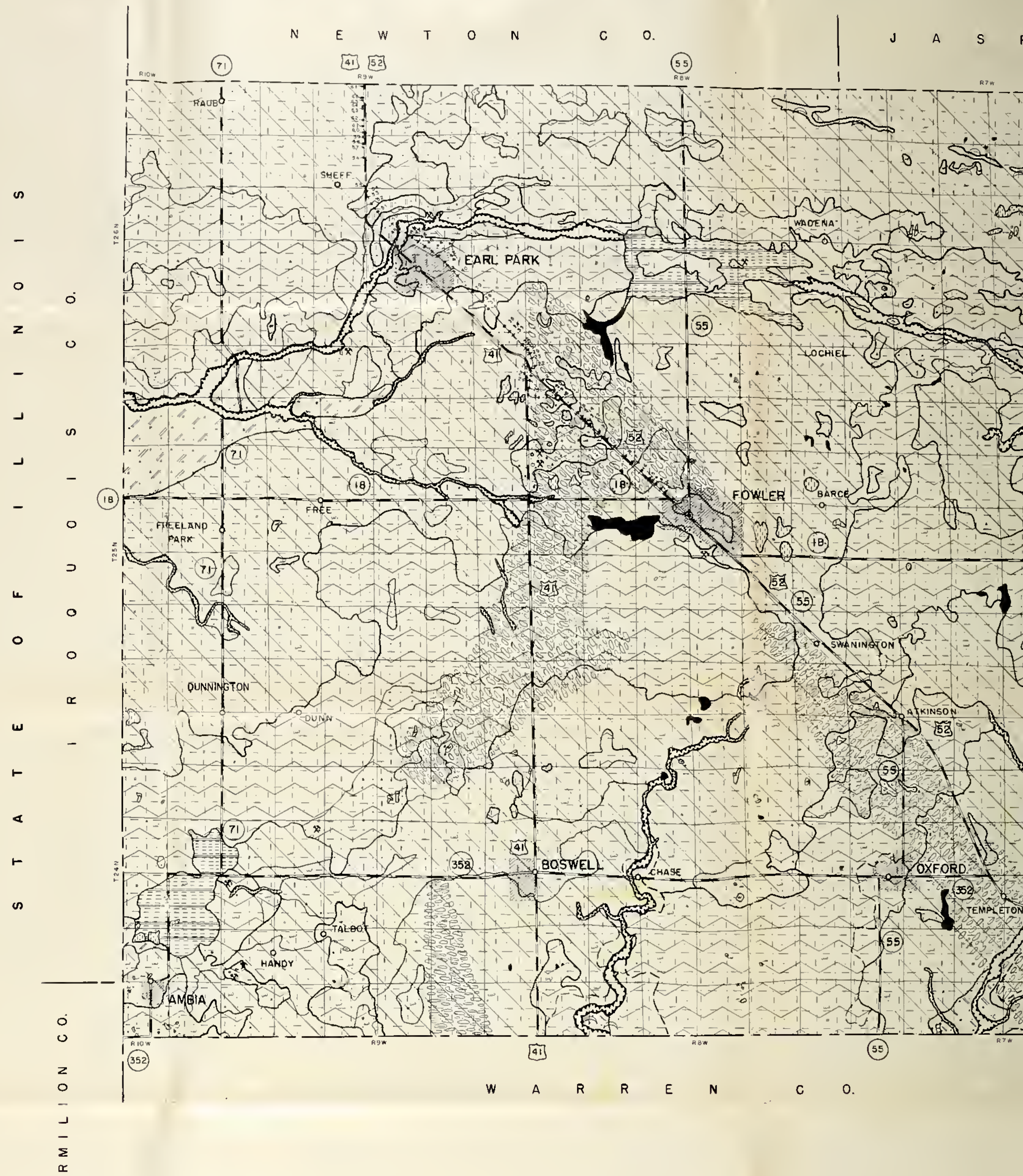




ENGINEERING SOILS MAP

BENTON COUNTY

INDIANA

PREPARED FROM

1940 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT, PURDUE UNIVER

SPONSORED BY

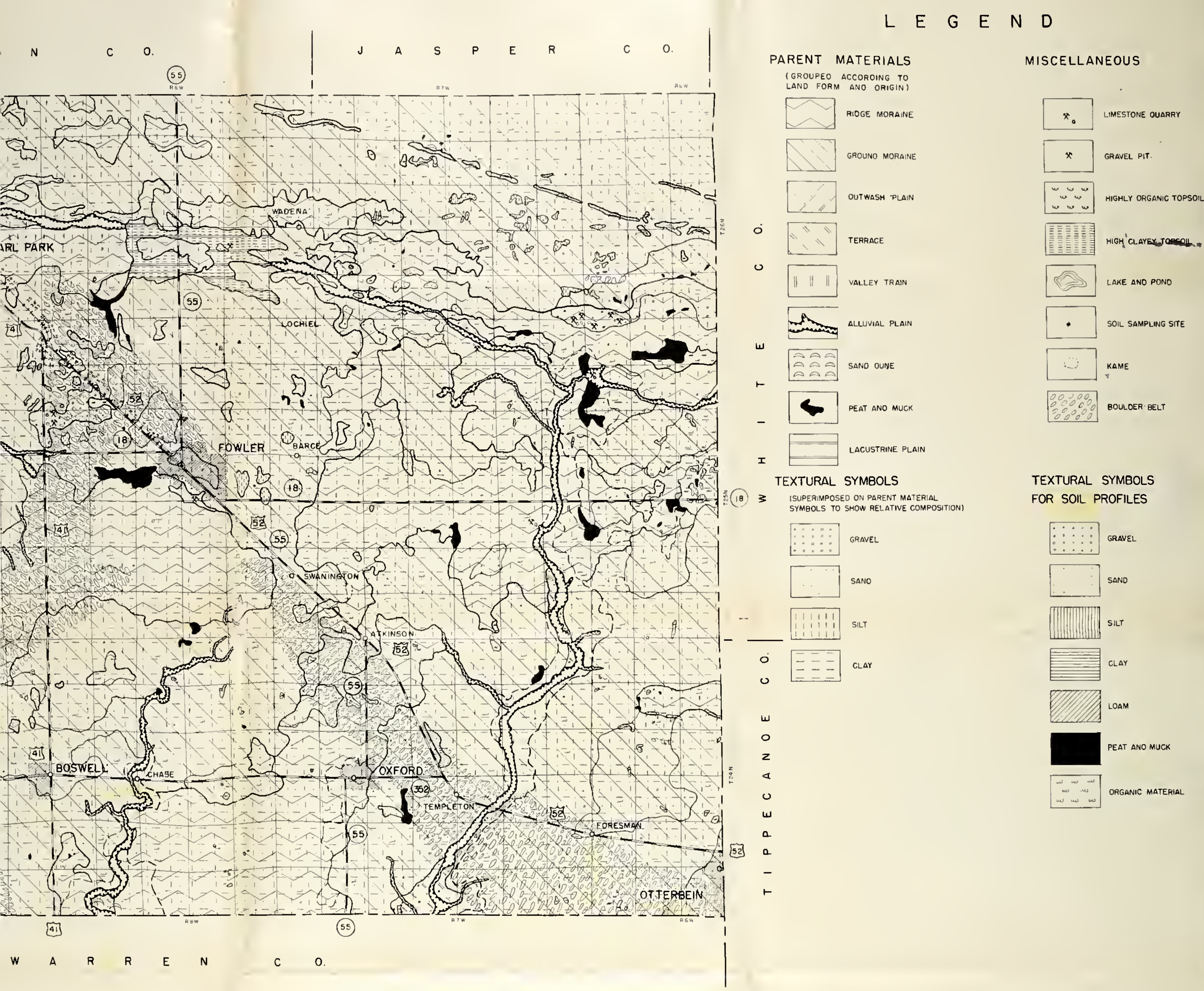
INDIANA STATE HIGHWAY COMMISSION

1969

SCALE OF MILES

POLYCONIC PROJECTION

PREPARED UNDER THE SUPERVISION OF P T YEH



ENGINEERING SOILS MAP

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SCALE OF MILES

POLYCONIC PROJECTION

DRAWN BY: GUSTAVO PENA, ROBERT KANTZ, AND RALPH HERRICK